



## Authorizations and Permits for Protected Species (APPS)

File #: 22187

Title: Physiological, behavioral, and ecological stu

Modification: 8

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#### Applicant Information

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#### Project Information

**File Number:** 22187

**Application Status:** Application Complete

**Project Title:** Physiological, behavioral, and ecological studies of northern elephant seals (*Mirounga angustirostris*) in Central California

**Project Status:** New

**Previous Federal or  
State**

18523

**Permit/Authorization:**

<b>Permit/Authorization Requested:</b>	• MMPA Research/Enhancement permit - Issued
<b>Where will activities occur?</b>	California (including offshore waters) US Locations including offshore waters
<b>Research Timeframe:</b>	<b>Start:</b> 04/10/2018 <b>End:</b> 03/31/2024
<b>Sampling Season/Project Duration:</b>	The proposed research would focus primarily on northern elephant seals at the Piedras Blancas Rookery in San Simeon, CA, but would also include new pupping beaches at Vandenberg AFB. Research would be conducted year-round on all age classes, with increased frequency and effort during the breeding season (December-April). The duration of the requested permit is five years.
<b>Abstract:</b>	<p>Northern elephant seals (<i>Mirounga angustirostris</i>; NES) are a well-studied model species for pinniped physiology and behavior, but their biology is only well known for part of their range. Piedras Blancas (PB), in Central California, is the site of the largest mainland colony of NES, yet no formal population monitoring program currently exists. The PB colony lies approximately in the middle of the NES distribution, but represents a void of data for NES population patterns, behavior, breeding, and other important knowledge otherwise present at other NES sites throughout California, Oregon, and Mexico. This study will establish a population of known individual NES at the Piedras Blancas colony via marking, tagging, and weighing of young-of-the-year, to lay the groundwork for directed studies on known-age individuals, and will initiate non-invasive physiological studies for comparison to animals at Año Nuevo. This project will be the first formal longitudinal study of this population, and will also allow for novel comparisons of behavior and physiology of NES between PB and other known colonies.</p> <p>Sample sizes requested are large to allow for marking and tagging of sufficient proportions of the colony for future studies on known-age individuals. All age classes of animals of both sexes will be taken. Types of takes include behavioral observations and measurements, bioacoustic recordings, marking, flipper tagging, capture, and non-invasive physiological sampling. A total of 64,927 NES will be taken per year for five years: 3,550 handle/release takes, 500 capture/handle/release takes, 1,575 harassment takes, 59,000 incidental disturbance takes, no more than 2 unintentional mortality takes annually (5 for the life of the permit), and 300 export/receive only takes.</p>

## Project Description

**Purpose:** This study will establish a population of known individual NES at the Piedras Blancas colony via marking, tagging, and weighing of young-of-the-year, to lay the groundwork for directed studies on known-age individuals, and will initiate non-invasive physiological studies for comparison to animals at Año Nuevo. This study will also tag young-of-the-year at the emergent colony at Vandenberg Air Force Base so that we can monitor population growth and migration of seals born at this newly established rookery.

Piedras Blancas (PB) in Central California is the site of the largest mainland colony of northern elephant seals (*Mirounga angustirostris*, NES). The colony was established in 1991, currently spans 6 miles of beach, and lies approximately central to the NES distribution. It has grown rapidly over the past three decades since its establishment, yet there has never been a formal population monitoring program at PB and total population estimates have never been published. At nearly all of the other NES-colonized sites, publications have documented rigorous population monitoring methods as well as growth trends since the initial colonization (Allen et al., 1998; Bartholomew and Hubbs, 1960; Le Boeuf et al., 1974; Le Boeuf and Panken, 1977; Mate, 1969; Mesnick et al., 1998; Stewart and Yochem, 1986; Zenkovich, 1998). The PB colony represents a void of data for NES population patterns, behavior, breeding, and additional important knowledge otherwise present at other NES sites throughout California, Oregon, and Mexico.

In the past few years, NES have begun pupping at Vandenberg Air Force Base (VAFB), which lies 14 miles north of Lompoc in central California, approximately 80 miles south

of the PB rookery. NES have used these beaches as haul-outs for a number of years, but there were no pups born at this location until December 2016. There were 19 pups born at VAFB in December 2016 and 24 pups born at VAFB in December 2017 (R. Evans and T. Whitsitt, pers. comm.), confirming that this is likely a newly established rookery. Thus, this provides us the unique opportunity to study the population dynamics and behavior of an emergent rookery.

This study is an expansion of a long-term monitoring program that began at University of California Santa Cruz (UCSC) in 1968 at the Año Nuevo NES colony. Over the past 40 years, research at Año Nuevo has provided a wealth of information on northern elephant seal population dynamics, behavior, physiology, and bioacoustics (see LeBoeuf et al., 1994 for a review; Costa et al., 2003; Southall et al., 2003; Ferraro et al., 2017). Although UCSC has permits to conduct research on any rookery within California, their research has primarily focused on the Año Nuevo population. These data have been used to make general inferences about other NES colonies, but the lack of information about other colonies makes it difficult to know how accurate and applicable these inferences are.

Our research program will investigate many of the same topics as the UCSC research team, but our research will focus primarily on the PB rookery, as there is little scientific information about that colony. This research is crucial in determining the large-scale trends in the NES population, migration between colonies, and how comparable colonies are to one another with respect to factors including demographics, behavior, and physiology. Because the rookery at VAFB is so new and relatively difficult to access, we will focus only on flipper tagging weanlings at that site for now. Although the UCSC team is permitted to work at PB and VAFB, they have neither the means nor the manpower to conduct focused research at those sites. We launched our pilot program under the Costa permit (19108), and Dan Costa has requested that we obtain our own permit so that it can be managed locally (through Cal Poly rather than UCSC). We will continue to actively collaborate with Dan Costa (UCSC) and Dan Crocker (Sonoma State), as well as Gitte McDonald (Moss Landing Marine Laboratories). However, we require our own permit in order to properly manage the research, as well as to cultivate the local relationships with California State Parks, the Friends of the Elephant Seal, and the biologists at VAFB. This is important research to help us better understand the fastest growing northern elephant seal rookery in the entire range, and our team is best situated to accomplish it.

#### Project Objectives

The primary objective of this project is to establish a long-term research program at the Piedras Blancas and Vandenberg Air Force Base elephant seal rookeries. To do so, we will collect data in three main areas of research: a) population trends, b) basic physiological characteristics, and c) bioacoustics. Our population studies are designed to establish baseline data for future hypothesis-driven research, and the physiological and bioacoustics studies are designed to collect data for direct comparison with studies conducted at Año Nuevo.

a. Population Studies: The overarching goal of the population studies is to provide a large data set for assessing population demographics and migratory patterns of the PB and VAFB rookeries. We will be collecting data on fundamental demographic processes, including survival, reproduction, and the carrying capacity of the rookery. These data will be used to measure and estimate migration, age, birth rates, death rates, life histories of individual animals, local distribution, reproductive histories of individuals, and tag loss data (Bonnell et al., 1978; Reiter, 1984; Le Boeuf and Reiter, 1988; Le Boeuf and Reiter, 1991; Barlow et al., 1993; Lowry et al., 2014). The specific objectives are twofold: (1) to document population growth and movement data for these growing rookeries and (2) to establish a sub-population of known-age individuals that will enable more directed studies in the future.

Hypothesis A1: The population growth rate at Piedras Blancas will slow as the rookery approaches carrying capacity.

Hypothesis A2: The new population at VAFB will exhibit exponential growth over the next several years.

All procedures proposed are based on methods used at Año Nuevo (#19108). At PB, we propose to mark individuals of each age/sex class with temporary hair dye or hair bleach

(lasts one year) to easily resight and track individuals to assess mating success, natality, and weaning success. We also propose to flipper tag approximately 1/2 of the number of pups weaned at PB in 2010 (2500 animals), which is estimated to be about 1/4 of the number of pups projected to wean in 2019, on an annual basis. These estimates are based on reports of 4469 pups born at PB in 2010 and an average growth rate of 10.8% per year (Lowry et al., 2014). These are conservative requests, balancing our need to tag a significant proportion of the colony with the feasibility of accessing such a large number of animals. In addition, we propose to flipper tag all of the pups born at VAFB, which we conservatively project to be up to 50 animals each year. This estimate is based on a 26% increase from December 2016 (19 pups) to December 2017 (24 pups), which would yield 30 births in December 2018 at the same growth rate, with 20 additional takes allowing for the likelihood of exponential population growth at this early stage of the rookery's establishment.

Weighing studies of NES weanlings at PB will provide baseline information on average weaning conditions for this population, which is essential information because weaning mass is related to future success and recruitment into the breeding population (Le Boeuf and Reiter, 1988). We will conduct regular ground surveys at PB (at least weekly during the breeding season and at least once per month during the molt) to perform resights of marked and tagged animals, observe behavior of marked animals during the breeding season, estimate pup weaning dates, and track the demographic composition of the beaches throughout the year. We have trained the docents of the Friends of the Elephant Seal to contribute additional resight data as citizen scientists. The biologists at VAFB perform monthly surveys of the rookery there. When possible, we will perform additional surveys during the NES breeding season at VAFB in an effort to increase survey frequency.

Consistency of tagging effort and strengthening of our analyses will be achieved by combining our database with the historical database at UCSC. We are currently collaborating with UCSC for this study under permit #19108, and they are supportive of our efforts to establish an independent research program (D.P. Costa and D.E. Crocker, pers. comm.). Our project will add information about a previously understudied population and will facilitate direct comparisons among study rookeries. We will also share tag resight data with other elephant seal research groups, including researchers at Humboldt State and in Mexico.

b. Physiological Studies. The physiological aspect of this research will provide comparative data for direct comparison to the seals at Año Nuevo. Physiological studies will be focused at PB, where accessibility to the animals is consistent and results in minimal disturbance to non-target species. The two broad categories of physiological research we propose are: i) thermoregulation and ii) kinematics.

Hypothesis B0 (null hypothesis): The thermal physiology and kinematics of NES at PB will be indistinguishable from those of the NES at Año Nuevo. If this hypothesis is supported, we can expect that regional studies on northern elephant seals will be applicable to the greater population.

Hypothesis B1 (alternative hypothesis): The thermal physiology and kinematics of NES at PB will be significantly different from those of the NES at Año Nuevo. If this hypothesis is supported, it will suggest that northern elephant seals have begun to adapt locally at different rookeries, which is scientifically interesting for a species that has been through a severe genetic bottleneck.

i) Thermoregulation: Infrared thermography (IRT) provides a non-invasive method to measure the radiation emitted from an object, which can then be converted to temperature (Codde et al., 2016). IRT will be used to examine general thermoregulatory strategies of the different age classes and sexes of seals during rest and before and after certain behaviors. We will also be using IRT to measure the temperature of certain structures in adults and pups (e.g., the vibrissal system) to establish a more complete understanding of their anatomy and use of thermal windows. We will explore a number of possible research questions, including the thermal effects of territorial behavior in males, the effects of sand flipping on thermal biology, and the ontogeny of vasocontrol.

ii) Kinematics: Male NES must perform burst movements when defending their harems or challenging other males (Stewart et al., 1994), and these movements have recently

been shown to be inefficient and costly for the seals (Tennett et al., 2018). We will compare these movements to those of subordinate males (being chased) and adult females (defending their pups) during the breeding season. Four-hour video footage of target animals will be collected three times per week throughout each breeding season to analyze the kinematics of land movements. The frequency, speed, and duration of specific land movements will be measured, particularly those most potentially affected by hypertrophy in fast-twitch oxidative and glycolytic fibers (e.g., chasing or being chased, male-male combat). Analysis of kinematic movements will provide a better understanding of the energetic costs associated with breeding behaviors across the population.

c. Bioacoustic Studies. Our baseline estimates for acoustic studies will be completed by taking source and background sound pressure level (SPL) measurements at the PB colony. (No bioacoustics studies will take place at VAFB for the time being.) This will give us an estimate for the distance over which sounds can be heard over background noise for a particular environment. Previous studies provide reliable measures of both in-air and underwater critical masking thresholds for pinnipeds (e.g., Southall et al., 2000; 2003), but baseline source level measurements of vocalizations are limited (Schusterman and Moore, 1978; Insley, 1992; Reiman and Terhune, 1993; Sanvito and Galimberti, 2003; Southall, 2003), and have never been studied at the PB rookery. Our research will broaden the database of pinniped acoustics to better understand how natural acoustic disturbances influence NES social ecology.

Hypothesis C0 (null hypothesis): The bioacoustic signals of NES and the influences of those signals on social behavior at PB will be indistinguishable from those observed for NES at Año Nuevo.

If this hypothesis is supported, it will suggest that there are no "dialects" at different rookeries, and animals that move among rookeries will behave similarly with regard to bioacoustic signaling (as senders and receivers).

Hypothesis C1 (alternative hypothesis): The bioacoustic signals of NES and/or the influences of those signals on social behavior at PB will be significantly different from those observed for NES at Año Nuevo.

If this hypothesis is supported, it will suggest that there may be "dialects" at different rookeries, and/or animals may exhibit different behaviors with regard to bioacoustic signaling (as senders or receivers).

i) Passive Acoustics. These studies will utilize passive, non-invasive acoustic measurements on land. This will help us better understand how sounds and vocalizations influence the social behavior of elephant seals at the PB colony. Previous studies have shown that males exhibit individually distinguishable calls, but there may not be "dialects" at different rookeries (Shipley et al., 1981); this work will explore whether that holds true for PB, and will compare sounds of PB animals to those at other rookeries. These data will also be used to assess how exposure to natural acoustic disturbance may disturb northern elephant seals.

ii) Acoustic Playbacks. Our bioacoustics studies will also use acoustic playbacks of vocalizations from all age classes and sexes. These playbacks will help us to better understand the importance of vocalizations in a social context. We will combine these acoustic playback techniques (Insley et al., 2003) with our data from passive acoustic sampling (SPL and vocal structure) to provide a deeper understanding of ecological dynamics.

**Description:** Overview

The procedures requested have been previously authorized and performed under NMFS Marine Mammal Research Permits #496, #836, #786-1463, #87-1743, #14636, #19108, and their authorized modifications issued to D. Costa. All of the requested activities were approved in similar numbers in permit #19108 and performed without incident by all authorized permittees, including H. Liwanag. The PI (Liwanag) and field leaders have been working with NES at PB for more than 6 months. Liwanag, Weitzner, Voisinet, and Cooper were trained extensively by researchers at UCSC, where many of the procedures and techniques requested were developed. The present study is modeled after the

elephant seal research program at Año Nuevo but will allow new information to be gathered for an important population that has never been formally studied. The proposed methods are the same as those used at Año Nuevo, where there has been no evidence or indication that research efforts have adversely impacted the animals or the colony as a whole (McMahon et al., 2008). For example, research presence at certain areas of the Año Nuevo rookery have not led to decrease in use by seals, and site fidelity has been unaltered by any research activities (P. Robinson, pers. comm.). In the first field season of research at PB conducted by Liwanag under permit #19108, we have documented few incidental takes and have not observed any changes in beach composition or mom-pup separation rates. We expect that by using the same techniques as the Año Nuevo research program we will effectively minimize disturbance of the PB colony.

Animals will be taken primarily during the breeding season (December-April) and periodically during the remainder of the year. Takes will center around the Piedras Blancas elephant seal rookery, which spans 6 miles of beach from Point Piedras Blancas on the central coast of California, located about 40 miles north of San Luis Obispo and 90 miles south of Monterey. Additional takes will primarily occur at the new rookery at Vandenberg Air Force Base, 14 miles north of Lompoc in central California, approximately 80 miles south of Piedras Blancas. All permitted research activity will be reported to local NMFS authorities as required under normal responsibilities of permit holders. The research team has also established a working relationship with California State Parks, the authority over the land used by NES at PB, and with the Biological Scientist team at Vandenberg Air Force Base. Our target species is not ESA-listed and is not MMPA-depleted.

Our methodology is nearly the same as that of the NES research program at Año Nuevo, but our work is in no way duplicative. The present research team has collaborated closely with Dan Costa's lab at UCSC; though previous permits have included the PB colony, no research has ever been conducted at this colony, with the exception of tag retrieval for studies based elsewhere (D.P. Costa, pers. comm.). The only procedure that has been performed on the seals at PB is the annual flipper tagging of weanlings performed by Brian Hatfield (under Brent Stewart's permit). Hatfield has tagged a small percentage of the population for about 30 years, but has not made the data publicly available. Costa and Hatfield have both supported and endorsed our creation of an independent research program at PB, preventing any potential duplicity of research. Indeed, we will be directly entering our tagging, marking, and resight data into the northern elephant seal database maintained by Costa's lab (and managed through the Smithsonian Institute). Physiological and bioacoustics studies will be performed with the intent of making comparisons to the studies conducted at Año Nuevo.

#### Research Procedures

All handling techniques conform to standard protocols, and in addition to having MMPA approval, our protocols have already been approved by the California Polytechnic State University Institutional Animal Care and Use Committee (#1711).

##### Take Category 1: Tagging and marking studies

The main purpose of the initial tagging and marking study is to establish a known population of NES at PB and to provide a foundation for assessing the status of the PB colony relative to the overall NES population. A brand-new rookery was just established at VAFB in December 2016, and tagging any new pups born there would provide a unique opportunity to monitor this rookery nearly from its conception.

2,550 weaned pups of both sexes (approximately 50% of the number of pups born in 2010 at PB, and approximately 25% of the number of pups expected in 2019 (Lowry et al., 2014); plus all of the pups born at VAFB) and 1,000 adults will be tagged with plastic Roto-tags and/or marked with hair dye or hair bleach. Up to 17,750 NES may be incidentally disturbed per year during these activities. The number of incidental disturbances is a conservative estimate (i.e., likely an over-estimate), based on variability in the density of NES on different beaches and at different times.

a. Marking - PB only

The pelage of target animals will be marked using hair dye or hair bleach. Identifying marks (combinations of letters and numbers) are hand-applied to the pelage with a marking stick or via hand-application and is preferentially carried out while the animal is sleeping, causing less disruption. Animals will be marked with letters and/or symbols of minimum size.

Marks are lost during the seasonal molt. Pups younger than 1 week will not be marked or tagged to allow for enough time for the mother-pup bond to form. Similarly, females with dependent pups younger than 1 week will not be marked. Marking and tagging will also not interrupt observable mom-pup interactions, such as nursing or visible bonding behaviors.

b. Tagging - PB and VAFB

Roto-tags (global sheep tag, 5/8 in. wide x 2 in. high, Allflex USA) will be inserted into the interdigital webbing of hind flippers using specialized pliers. Each animal will receive 1 tag in one or both rear flippers. Restraint of animals is typically not required during these activities unless re-tagging or adjustment is necessary. When restraint is necessary, the animal will be manually restrained by hand, hoop net, head bag (mesh bag with soft, breathable material at the apex), or pup bag (canvas bag with a hole at the apex for breathing); this restraint will occur for the minimum time necessary to insert the tag (typically less than a minute). For animals with no flipper tags that are also receiving other treatments involving handling (described below), flipper tags and/or marks will be applied at that time.

c. Resights – PB and VAFB

Ground surveys will be conducted on a regular basis to resight marked and tagged animals, observe behavior of marked animals during the breeding season, and estimate weaning dates of young-of-the year. These surveys will be conducted on trails overlooking the study beaches, and therefore will not result in incidental disturbance of animals. We will use spotting scopes, binoculars, and/or zoom lenses to identify and observe animals from a distance.

At PB, there are seven distinct beaches included in our regular surveys. We will survey every beach at least once per week during the breeding season, and at least once per month during the annual molt. We have trained the docents of the Friends of the Elephant Seal to contribute additional resight data as citizen scientists; these efforts will be focused at the public viewing beaches (two of the seven study beaches). We will also perform resights on beaches opportunistically, when performing other procedures. This will allow us to obtain additional resights without increasing incidental disturbance for resights alone.

The biologists at VAFB perform monthly surveys of the rookery there. When possible, we will perform additional surveys during the NES breeding season at VAFB in an effort to increase survey frequency.

Take Category 2: Weigh, measure, and sample

These procedures will provide a basis for the anticipated long-term assessment of colony health, reproductive success, parental investment, physiology, behavior, and ecology, and can also be used to measure the effects of climate change and/or other factors. These procedures will only be performed at the PB rookery.

Weanlings will be captured in a specially-designed canvas weigh bag (5'1" long, 3'1" at the opening, 7" across at the nose hole; SLO Sail & Canvas) with a 7" hole at the apex for breathing and a drawstring (rope) at the primary opening to gently cinch the animal in the bag. This bag was designed after the weigh bags currently used at Año Nuevo and was successfully piloted at PB in the 2018 breeding season. The animal's flippers hang out of the bag when the seal is fully inside. 500 weanlings will be captured once annually. This is approximately 10% of the number of pups born annually at PB by 2010 (Lowry et al., 2014). All animals will be handled (restrained, weighed, measured) and released. Up to 20,000 animals may be incidentally disturbed during these handlings. The research team generally targets isolated weanlings or individuals in small groups of weanlings, which results in few incidental disturbances. Occasionally, target weanlings (e.g., animals that were dye-marked and have a known weaning date) are situated in large "pods" of weanlings, and in those cases incidental disturbance numbers are higher.

Weaned pups will be weighed in the weigh bag and suspended from a load-cell scale and carbon fiber tripod. This has been the standard method for weighing pups since 1978 without incident (Reiter et al., 1978; D. Costa, pers. comm.).

Morphometric measurements (girths, standard length, curvilinear length) will be taken using a tape measure, and we will measure dorsal and lateral blubber depth along different points of the body using ultrasound. Animals will also be sampled opportunistically to assess hormonal and/or health parameters (hair clippings, ectoparasites, orifice (ocular, nasal, oral, anal, vaginal) swabs).

#### Take Category 3: Infrared thermography and kinematics

To assess morphology and thermal properties of elephant seals, infrared thermography (IRT) will be performed with a FLIR infrared thermal camera. Thermal images will be taken at a distance of 1-5 m from the subject. Subjects of IRT must be still, so images are captured primarily while animals are sleeping or resting, causing minimal disturbance. The camera will take simultaneous digital photographs for comparison to thermal images and photogrammetric measurements. These studies will be longitudinal to assess changes during ontogeny and/or seasonally, so we are requesting up to 10 takes per animal to gain an adequate temporal cross-section (e.g., 1 take every 2 weeks throughout the breeding season).

The kinematics of movements on land by seals will be assessed using video footage. Footage will be taken using a DSLR camera or GoPro from a distance. We will gather up to 12 hours of footage each week over the course of the breeding season (December-April). These studies aim to investigate the change in movements throughout the breeding season. Due to the longitudinal nature of the data, we are requesting up to 10 takes per animal.

250 pups (> 1 week)/weanlings and 250 adults of both sexes will be targeted for IRT and kinematics videos. Up to 5,000 animals may be incidentally disturbed during these activities, as procedures will be conducted to preserve natural behavior and therefore minimize disturbance.

#### Take Category 4: Bioacoustics

Bioacoustics observations and analyses will provide information on the effects of natural sounds on the ecology and behavior of NES. These studies will only be performed at PB, where we have reliable and consistent access to animals with minimal chance of disturbing non-target species. Acoustic measurements will also provide information regarding social communication at PB, for direct comparison to the studies performed at Año Nuevo.

##### a. Passive Acoustic Sampling

Each year we will obtain source-level recordings of up to 1,000 seals of all ages and sexes. These recordings are non-invasive - with a similar level of disturbance as tag-reading - and are typically measured at a distance of 5-15 m. This distance allows calls to be obtained with minimal background noise while staying below the response threshold distance of the recorded animals. To obtain source-level recordings from specific individuals (e.g., marked animals), recordings will be made with a microphone at a distance of 1 m only when a close approach is possible with minimal disturbance to natural behavior. Only personnel experienced in moving in and around NES will be conducting the acoustic recordings. Up to 5,000 animals may be incidentally harassed during these activities.

Calibrated recordings of aerial vocalizations and baseline noise levels will be made in and around the Piedras Blancas colony. Ambient acoustic recordings will be made to inform initial active space estimates and to quantify fluctuations in activity level. Vocalizations will be recorded for source material for playback, and to obtain source levels for active space estimates as well as to quantify call variability and directivity. Direct measures of aerial vocalization SPL (dB re: 20 $\mu$ Pa) will be obtained using a precision sound level meter (Larson-Davis 831, fast response settings). Natural sounds such as ocean surf will also be recorded as source material for playback (sampling rate = 48 kHz; 50Hz-20kHz). These measurements will be utilized to characterize sounds experienced by the seals, and to calibrate our playback experiments.

#### b. Acoustic Playbacks

We will complete playback experiments for up to 50 adults and 25 pups (> 1 week)/weanlings of both sexes in each year, which will test recognition abilities and reveal prominent acoustic features in vocal communication. Playback experiments may potentially alter individual seals' behavior, but all playbacks will be brief in nature (?5 minutes) and will never be louder than naturally occurring vocalization source levels. The maximum level for playbacks is 120 dB (Leq) and 130 dB (Lpk) at one meter from the playback speaker; we will not exceed this level, and most playbacks will occur below it. Wherever possible, playback levels will be matched to the actual source level of the recorded caller or sound. For example, male calls average  $116 \pm 1.5$  dB (SPLpeak, re: 20uPa; Mathevon et al., 2017), whereas the calls of subadult males, females, and pups tend to be much quieter (80 - 110 dB; SPLpeak, re: 20uPa). At the receiver, assuming the closest playback distance of 5 m, received levels from 120 dB playbacks should be < 108 dB (Leq) and 118 dB (Lpk). Although adult male calls are considered to contain impulsive components (Casey et al., 2015), these levels are well below the permanent threshold shift levels for non-impulsive and impulse sounds for phocids, as defined by the U.S. Navy (Navy Technical Guidance, Table C.2.). We expect brief and minimal responses from the seals, if any (e.g., an orientation or call in response but nothing more). The source of the playback speaker will be 5-20 m from the target animal. In most cases, the playback distance will be fixed to 7 m (at 0 degree orientation) to the target animal to allow standardized response measurements to be obtained.

Each playback will be brief (approximately 5 min. maximum duration, including blank intervals between sounds), and may include elephant seal vocalizations and/or natural sounds such as ocean surf as control sounds. Playbacks will not repeated for at least 2 hours on that beach to avoid disruption of normal behavior; therefore, a given beach will likely experience 2 playbacks in a day, and certainly no more than 4 trials in a day. Playbacks to females and pups will only be conducted on individuals on the periphery of a group so that if either moves towards the sound source, they will have a clear/unimpeded path back to their pup/mother. We expect individuals to experience no more than 20 minutes of total maximum playback exposure per 24-hour period.

Playback experiments will only be in air and will be conducted on all age and sex classes at natural SPLs, excluding pups less than one week old and adult females with dependent pups less than one week old. Playbacks will be conducted either directly from a computer or from prerecorded signals. Signals will be broadcast through portable self-amplified speakers (Acoustic Research 40Watt Powered Partners or equivalent) placed within audible range of the test subject (e.g. 5-20 m) at natural call SPLs (measured prior to experiments at 1 m with Larson-Davis sound pressure level meters). All experiments will be recorded on video for detailed scoring in the laboratory.

Behavioral reactions such as orientation, calling, and phonotaxis (i.e., directional movement) will be used in a scoring rubric. Up to 11,250 animals may be incidentally harassed

during these activities (approximately 15 animals per target animal).

#### Non-Target Species and Incidental Harassments

During the combined research activities, up to 59,000 NES may be incidentally harassed annually.

Up to 100 California sea lions, *Zalophus californianus* (CSL), 100 harbor seals, *Phoca vitulina* (HS), and 25 northern fur seals, *Callorhinus ursinus* (NFS) may be incidentally harassed annually during research activities. This could occur if any of the listed species happen to be hauled out near research procedures, though the chance of that occurring is small. CSL, HS, and NFS are not listed as depleted under the MMPA and are not threatened or endangered under the ESA.

#### Unintentional Mortality or Serious Injury During Research

Maximum number of animals that could die or be seriously injured per year: 5 animals over the life of the permit (not to exceed 2 per year). Incidental mortalities have been extremely rare in this research system and have in almost all cases been associated with pre-existing conditions not evident when choosing the animal. The research program at UCSC experienced the loss of one animal in the last five years during recovery from anesthesia. This animal showed evidence of a fish bone that had perforated the intestine, and the animal had developed sepsis and disseminated intravascular coagulation (DIC) prior to being handled. The animal appeared to be in good health prior to the procedure and provides good evidence of the ability of the species to mask serious health conditions. Every effort is made to select subjects in good health based on coat and mouth color characteristics. However, it is possible that the stress of handling could cause hidden problems to manifest in an animal that otherwise appears healthy; this is why we need to include the possibility of unintentional mortality in our take table, even with our relatively non-invasive procedures. In the event of an injury during a procedure without a vet present, we will call the Morro Bay branch of The Marine Mammal Center, located 25 miles south of the PB field site, where Dr. Heather Harris serves as a contract veterinarian.

In the case of an accidental mortality, blood samples will be collected for chemistry and hematology analysis. The carcass will be secured for a full necropsy by individuals from The Marine Mammal Center (TMMC) in Morro Bay as soon as possible. If it is an adult animal, the carcass would be either buried or allowed to be taken by the tide after the necropsy. If the mortality is a female with a dependent pup, we will notify NOAA and we will actively consult with the marine mammal stranding network (TMMC) to monitor/assess the pup's condition and determine whether the pup is a candidate for rehabilitation or likely to survive as an early weanling. Assessment criteria will include length/width ratio, date of incident relative to peak pupping, and molt status of the coat.

#### Salvage of Deceased Animals

We will salvage parts of up to 300 animals found dead of natural causes. Muscle and other tissue samples may be collected, sculps (blubber, skin, and hair) for various physiological analyses (detailed under NMFS permit 18523), blood, and milk. Muzzle samples (whiskers and underlying tissue) may be collected for histological analysis of the vibrissal system. For muzzle sampling in particular, adult animals represent a crucial age class for which it is difficult to obtain samples through stranding networks or rehabilitation facilities. Encountering a suitable adult carcass without tissue decay is quite rare; we may encounter one or two such carcasses in an entire year. Therefore, this sampling opportunity is rare and of great scientific importance for the characterization of the vibrissal system, a critically important sensory system in deep-diving seals such as elephant seals.

We will only perform sampling from carcasses when we can avoid being in view of the public during sampling. The salvaged carcasses will be left in their original positions if

the carcass and/or sampling marks are not in view of the public. If a carcass is potentially in public view with visible sampling marks, it will be moved to a location (tide line or hidden area of beach) out of view, or buried in the sand for natural decay. We have consulted with the MMHSRP for the region, and have confirmed that we need to perform this sort of sampling ourselves because there is currently no person or organization responsible for handling pinniped carcasses in San Luis Obispo County.

No samples will be imported from outside of the U.S. under this permit. We are proposing local, opportunistic collection of samples. Recipients listed under this permit are U.S.-based researchers. Samples may be exported for analysis under NMFS permit #18523 (Liwanag).

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## Supplemental Information

**Status of Species:** Although driven nearly to extinction in the 19th century due to the fur and oil trade, NES have made a remarkable recovery and maintain a vast distribution (Stewart et al., 1994). Hunting brought the population down to an estimated 20-100 individuals on the Isla de Guadalupe, Mexico in 1890. In 1922, the Mexican government, followed shortly by the US government, granted protection of NES, and in the early 20th century the species began to expand their range, with observations documented from San Diego all the way up to Southeastern Alaska (Stewart et al., 1994). Between 1965 and 1991, the annual total population growth rate for NES was 6.3%, and from 1988 to 2010, the U.S. population has grown at an annual rate of 3.8% (Lowry et al., 2014; Stewart et al., 1994). A 2010 estimate put the population of NES in the U.S. and Mexico at between 210,000 and 239,000 (Lowry et al., 2014).

PB in Central California is the site of the largest mainland colony of NES, established in 1991 (Rick et al., 2011). This colony lies approximately in the middle of the NES distribution and has grown rapidly over the past two decades since its establishment, with an annual population growth rate of 10.8%. In 2010, PB was the third largest NES rookery with 4,469 births (Lowry et al., 2014). However, these population estimates have never been published; all PB population monitoring studies and reports have come from Brian Hatfield, whose contribution to NES literature has come in the form of personal correspondence and unpublished data (Lowry et al., 2014; Hatfield and Rathbun, 1999; Rick et al., 2011).

NES, CSL, HS, and NFS are not listed as "endangered" or "threatened" under the ESA nor as "depleted" under the MMPA. For NES, the total fishery mortality appears to be insignificant and approaching a zero mortality and serious injury rate for this stock, and the population continues to grow annually (Garrett et al., 2014a).

**Intentional Lethal Take:** We are not requesting any intentional lethal take under this permit. If a moribund or starveling orphaned pup is identified, The Marine Mammal Center (TMMC) will be notified. We will work with TMMC to determine whether the pup should be taken for rehabilitation or euthanasia, under their authority, in consultation with Dr. Heather Harris (contract veterinarian for TMMC in San Luis Obispo County). This is how all live response is handled for pinnipeds in this region.

There is a very slim chance of unintentional mortality during handling, and we have included 5 takes for unintentional mortality over the life of the permit, not to exceed 2 mortalities in a single year. Please see attachment for additional details.

**Anticipated Effects on Animals:** Effects on individuals will be minimal. There is no evidence from the previous research at Año Nuevo or other colonies that these studies would cause severe adverse effects on any individuals or the colony. Animals handled for marking, tagging, and weighing will undergo only a short period (no more than 30 min) of temporary stress associated with capture and/or handling. Decades of flipper tagging on NES at Año Nuevo provide evidence of extremely low risk of infection from flipper tags (<0.5%), and in the rare case of infection the tag is almost always naturally ejected from the flipper (P. Robinson, pers. comm.). Survival rates of animals that have been handled do not vary significantly from untouched controls. We have included up to 2 incidental mortalities to account for the natural survival rate and the chance that we may inadvertently interact with a moribund animal, but we do not expect any of our procedures to cause mortality. Studies conducted on southern

elephant seals found no impacts of handling on foraging success (McMahon et al. 2008).

Effects of incidental harassment on non-target animals are minimal as well. Elephant seals acclimate quickly to the presence of researchers and rarely leave the beach. There is neither evidence nor indication that the previous studies at Año Nuevo have adversely impacted individuals or the colony. In our first field season at PB we have had very few incidental takes (fewer than 3,000 individuals) and have not observed any changes in composition or mother-pup bonds on any beaches where we have conducted research. Areas of the rookery with a heavy research presence are well utilized by seals.

Researchers at UCSC found no significant impact of experimental procedures on weaning success, weaning weights, lactation durations, and site fidelity, and these variables were identical for experimental females compared to control animals (D. Costa and P. Robinson, pers. comm.).

Elephant seals are unquestionably the most robust of the pinnipeds to research handling. Animals routinely return to normal behavior shortly after handlings. Animals remain on shore following most handlings. Surrounding animals rapidly adapt to research presence and continue to sleep and exhibit normal behavior during procedures. Seals not involved in studies do not leave the beach and usually rapidly acclimate to the presence of the researchers. For example, mother/pup pairs adjacent to experimental procedures will most likely continue to sleep and suckle despite the presence of the research activities. Elephant seals are perhaps the most robust marine mammal in this regard.

#### **Measures to Minimize Effects:**

Study animals will be chosen carefully to minimize disturbance of other animals in the area. Movement to and from the sampling and observation sites will be done with caution to avoid close contact with any surrounding seals. All personnel leading the described activities are experienced in moving among and around elephant seals. Most visual observations, acoustic recordings, and thermal or other imaging can be made while at a distance from the seals (e.g. 5-50 m) and therefore cause little to no behavioral impact. Procedures requiring closer approaches (e.g., some acoustic recordings at 1 m) will be conducted with abundant caution to preserve natural seal behavior and minimize incidental disturbance. Any takes involving a lactating mother and pup are designed to give mother and pup time to bond and for the mother to demonstrate good maternal behavior before being selected for a study. We will take care to avoid disturbance of females with pups <1 week old, and will only target females and dependent pups located in the periphery of a group, to minimize the potential of separation and to minimize disturbance to other animals. If a dependent pup becomes separated from its mother by more than 5 m during our activities, we will cease activities and actively herd the mother in order to reunite the pair; we will observe the pair an additional 20 minutes after they are successfully reunited to ensure they remain bonded.

All procedures for animal handlings are based on 30 years of similar studies on northern elephant seals at the Año Nuevo rookery. Sterile technique is used to avoid infection, and elephant seals often exhibit open wounds and shark bites in a highly pathogenic environment with low incidence of infection, suggesting a strong innate immune ability. Careful assessment of an animal's health based on condition, coat, and mouth color are made before selection of subjects for procedures involving handling.

The timing of work at VAFB will be carefully planned to minimize the number of incidental harassments of non-target species. We will consult with the scientists at VAFB, Rhys Evans and Tiffany Whitsitt, to get up-to-date information about the study beaches before we conduct any field work at that site. Their survey efforts allow us to monitor numbers of animals on the beach, including California sea lions and harbor seals. We will pay particular attention to the progression of the harbor seal breeding season. To avoid unnecessary incidental harassment and the possibility of maternal abandonment, we will not conduct research activities after the first harbor seal pups are born.

**Resources Needed to Accomplish Objectives:** The primary investigator (Liwanag) has experience handling several pinniped species over the last 15 years, including phocid and otariid seals in captivity and in the wild, and thus exhibits sufficient expertise to accomplish the project goals. She was originally trained (as a graduate student) by the Costa lab at UCSC to perform these protocols with northern elephant seals. She has performed the procedures proposed here, including marking, tagging, weighing, morphometrics, infrared thermography, population and behavioral surveys, and animal handling and capture. Liwanag has published 10 peer-reviewed papers on thermoregulation and/or energetics in pinnipeds.

Please see attached document for full Resources Needed to Accomplish Objectives.

**Disposition of Tissues:** Tissue samples will be stored at Cal Poly in Liwanag's lab until analysis and will be made available for reasonable use to the greater scientific community.

**Public Availability of Product/Publications:** We expect this flagship study of the PB and VAFB colonies will generate multiple peer-reviewed scientific publications, with undergraduate and graduate students included as active coauthors. The research team will work in cooperation with CA State Parks and the Friends of the Elephants Seal to disseminate information gathered from these studies to the public via docents working at viewpoints and information bulletins. CA State Parks intends to use this information to directly inform their management of the lands as the animals at PB expand to new beaches. One of the primary educational goals of the project is to create an undergraduate course at Cal Poly centered on field work with the PB colony, which will facilitate the perpetual involvement of students in the proposed research.

## Location/Take Information

### Location

**Research Area:** Pacific Ocean **State:** CA

### Location Description:

## Take Information

Line	Ver	Species	Listing Unit/Stock	Production /Origin	Life Stage	Sex	Expected Take	Takes Per Animal	Take Action	Observe /Collect Method	Procedure	Transport Record	Begin Date	End Date
1	B	Seal, northern elephant	California Breeding Stock	Wild	Pup/ Juvenile	Male and Female	2550	1	Handle/Release	Other	Mark, bleach ; Mark, dye or paint; Mark, flipper tag; Observation, mark resight; Observation, monitoring; Observations, behavioral; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL)	N/A	1/28/2020	10/31/2023
<b>Details:</b> 1.a. Tagging and marking studies. Mark with bleach or dye using wooden marking stick (including dependent pups), tag with plastic rototag, behavioral observations and monitoring. Juvenile = weaned pups up to 3 years.														

2	B	Seal, northern elephant	California Breeding Stock	Wild	Adult	Male and Female	1000	1	Handle/Release	Other	Mark, bleach ; Mark, dye or paint; Mark, flipper tag; Observation, mark resight; Observation, monitoring; Observations, behavioral; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL)	N/A	1/28/2020	10/31/2023
<b>Details:</b> 1.a. Tagging and marking studies. Mark with bleach or dye using wooden marking stick, tag with plastic rototag, behavioral observations and monitoring.														
3	B	Seal, northern elephant	California Breeding Stock	Wild	All	Male and Female	17750	1	Harass	Other	Observation, mark resight; Observation, monitoring; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL)	N/A	1/28/2020	10/31/2023
<b>Details:</b> 1.b. Harassment from 1.a.														
4		Seal, northern elephant	California Breeding Stock	Wild	Juvenile	Male and Female	500	1	Capture/Handle/Release	Other	Mark, bleach ; Mark, dye or paint; Mark, flipper tag; Measure (standard morphometrics); Sample, clip hair; Sample, fecal swab; Sample, nasal swab; Sample, ocular swab; Sample, oral swab; Sample, other; Sample, swab all mucus membranes; Ultrasound; Weigh	N/A	4/10/2018	10/31/2023
<b>Details:</b> 2.a. Weigh, Measure, and Sample: Capture in canvas bag, weigh and measure, ultrasound, sample (hair, orifice swabs, other=ectoparasites), mark, flipper tag														
5		Seal, northern elephant	California Breeding Stock	Wild	All	Male and Female	20000	1	Harass	Other	Incidental disturbance	N/A	4/10/2018	10/31/2023
<b>Details:</b> 2.b. Incidental harassment from all 2.a. activities.														
6		Seal, northern elephant	California Breeding Stock	Wild	Pup/ Juvenile	Male and Female	250	10	Harass	Survey, ground	Observations, behavioral; Photogrammetry; Photograph/Video; Remote video monitoring	N/A	4/10/2018	10/31/2023
<b>Details:</b> 3.a. Infrared thermography and kinematics. Infrared thermography of dependent and weaned pups up to 3 years old, video recordings, photography, behavioral observations.														

7	Seal, northern elephant	California Breeding Stock	Wild	Adult	Male and Female	250	10	Harass	Survey, ground	Observations, behavioral; Photogrammetry; Photograph/Video; Remote video monitoring	N/A	4/10/2018	10/31/2023
<b>Details:</b> 3.a. Infrared thermography and kinematics. Infrared thermography, video recordings, photography, behavioral observations.													
8	Seal, northern elephant	California Breeding Stock	Wild	All	Male and Female	5000	1	Harass	Survey, ground	Incidental disturbance	N/A	4/10/2018	10/31/2023
<b>Details:</b> 3.b. Incidental harassment from all 3.a. activities.													
9	Seal, northern elephant	California Breeding Stock	Wild	All	Male and Female	1000	1	Harass	Survey, ground	Acoustic, passive recording; Observations, behavioral	N/A	4/10/2018	10/31/2023
<b>Details:</b> 4.a. Bioacoustics. Passive acoustic sampling.													
10	Seal, northern elephant	California Breeding Stock	Wild	Pup/Juvenile	Male and Female	25	10	Harass	Survey, ground	Acoustic, active playback/broadcast; Acoustic, passive recording; Observations, behavioral; Remote video monitoring	N/A	4/10/2018	10/31/2023
<b>Details:</b> 4.b. Bioacoustics. Acoustic playbacks. Acoustic playbacks of natural calls and novel sounds, recordings, behavioral observations.													
11	Seal, northern elephant	California Breeding Stock	Wild	Adult	Male and Female	50	10	Harass	Survey, ground	Acoustic, active playback/broadcast; Acoustic, passive recording; Observations, behavioral; Remote video monitoring	N/A	4/10/2018	10/31/2023
<b>Details:</b> 4.b. Bioacoustics. Acoustic playbacks. Acoustic playbacks of natural calls and novel sounds, recordings, behavioral observations.													
12	Seal, northern elephant	California Breeding Stock	Wild	All	Male and Female	16250	1	Harass	Survey, ground	Incidental disturbance	N/A	4/10/2018	10/31/2023
<b>Details:</b> 4.c. Incidental harassment from 4.b. activities.													
13	Seal, northern elephant	California Breeding Stock	Wild	All	Male and Female	1	1	Unintentional mortality	Other	Unintentional mortality	N/A	4/10/2018	10/31/2023
<b>Details:</b> 5. Unintentional mortality or serious injury during research; necropsy and collect tissue samples. Total of 5 takes for the life of the project, but up to 2 mortalities allowed in a single year before protocols must cease. NOAA will be contacted ASAP.													

14	Seal, northern elephant	California Breeding Stock	Wild	All	Male and Female	300	10000	Harass/Sampling	Other	Import/export/receive, parts; Salvage (carcass, tissue, parts)	N/A	4/10/2018	11/30/2023
<b>Details:</b> 7. Salvage and export world wide unlimited elephant seal samples from up to 300 animals (parts including but not limited to: blood constituents, skin, blubber, muscle, vibrissae, and milk).													
15	Sea lion, California	US Stock	Wild	All	Male and Female	100	1	Harass	Other	Incidental disturbance	N/A	4/10/2018	11/30/2023
<b>Details:</b> 6.a. Incidental disturbance to California sea lions during research.													
16	Seal, harbor	California Stock	Wild	All	Male and Female	100	1	Harass	Other	Incidental disturbance	N/A	4/10/2018	11/30/2023
<b>Details:</b> 6.b. Incidental disturbance to harbor seals during research.													
17	Seal, Northern fur	Range-wide	Wild	All	Male and Female	25	1	Harass	Other	Incidental disturbance	N/A	4/10/2018	11/30/2023
<b>Details:</b> 6.c. Incidental disturbance to northern fur seals during research.													

## NEPA Checklist

**1) If your activities will involve equipment (e.g., scientific instruments) or techniques that are new, untested, or otherwise have unknown or uncertain impacts on the biological or physical environment , please discuss the degree to which they are likely to be adopted by others for similar activities or applied more broadly.**

All of our procedures have been successfully performed on elephant seals and do not involve new equipment or techniques.

**2) If your activities involve collecting, handling, or transporting potentially infectious agents or pathogens (e.g., biological specimens such as live animals or blood), or using or transporting hazardous substances (e.g., toxic chemicals), provide a description of the protocols you will use to ensure public health and human safety are not adversely affected, such as by spread of zoonotic diseases or contamination of food or water supplies.**

To reduce risk, gloves and other appropriate PPE (lab-coats, eye shields) will be used when handling seals, blood and tissue samples (especially during necropsy). All personnel have been trained in safe animal handling procedures.

**3) Describe the physical characteristics of your project location, including whether you will be working in or near unique geographic areas such as state or National Marine Sanctuaries, Marine Protected Areas, Parks or Wilderness Areas, Wildlife Refuges, Wild and Scenic Rivers, designated Critical Habitat for endangered or threatened species, Essential Fish Habitat, etc. Discuss how your activities could impact the physical environment, such as by direct alteration of substrate during use of bottom trawls, setting nets, anchoring vessels or buoys, erecting blinds or other structures, or ingress and egress of researchers, and measures you will take to minimize these impacts.**

Our work will overlap with the Piedras Blancas SMCA/SMR, Cambria SMCA/SMP, and Vandenberg SMR. Our activities are limited to the beaches. We will not be directly altering substrate or building structures on the beaches or nearby dunes. We take special care to reduce trail formation when accessing beaches, and we have a zero-waste policy when working on the beaches (i.e., all waste is packed out and properly disposed off site).

**4) Briefly describe important scientific, cultural, or historic resources (e.g., archeological resources, animals used for subsistence, sites listed in or eligible for listing in the National Register of Historic Places) in your project area and discuss measures you will take to ensure your work does not cause loss or destruction of such resources. If your activity will target marine mammals in Alaska or Washington, discuss measures you will take to ensure your project does not adversely affect the availability (e.g., distribution, abundance) or suitability (e.g., food safety) of these animals for subsistence uses.**

We will be targeting NES in Central California, which does not allow subsistence hunting of marine mammals. None of our sites are eligible for listing in the National Register of Historic Places.

**5) Discuss whether your project involves activities known or suspected of introducing or spreading invasive species, intentionally or not, (e.g., transporting animals or tissues, discharging ballast water, use of equipment at multiple sites). Describe measures you would take to prevent the possible introduction or spread of non-indigenous or invasive species, including plants, animals, microbes, or other biological agents.**

Our project does not involve activities known or suspected of introducing or spreading invasive species, intentionally or not. All sampling (e.g., hair, orifice swabs, ectoparasites) will involve sterile technique for collection and transport of samples.

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### Project Contacts

**Primary Contact:** Heather E Liwanag

**Principal Investigator:** Heather E Liwanag

### Other Personnel

Name	Role(s)
Emily Christensen	Co-Investigator
Cameron Cooper	Co-Investigator
Joscelyn De La Torre	Co-Investigator
Elise Fiskum	Co-Investigator
Clinton Francis	Co-Investigator
Catie Halvorsen	Co-Investigator
Gillian Ippoliti	Co-Investigator
Kaitlyn Kaiser	Co-Investigator
Bryce King	Co-Investigator
Emily Levin	Co-Investigator
Anika Lewis	Co-Investigator
Molly Murphy	Co-Investigator
Linnea Erin Pearson	Co-Investigator
Kate Riordan	Co-Investigator

Emma Saenger	Co-Investigator
Gabriel Santos Elizondo	Co-Investigator
Madeline Schroth-Glanz	Co-Investigator
Melissa Voisinet	Co-Investigator
Emma Weitzner	Co-Investigator

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## Attachments

**Application Archive** - (Added Apr 10, 2019)  
**Certification of Identity** - (Added Apr 25, 2018)  
Contact - Anika Lewis (Added Jul 19, 2021)  
Contact - Anika Lewis (Added Aug 2, 2021)  
Contact - Bryce King (Added Sep 21, 2020)  
Contact - Cameron Cooper (Added Apr 25, 2018)  
Contact - Catie Halvorsen (Added Sep 21, 2020)  
Contact - Catie Halvorsen (Added Sep 21, 2020)  
Contact - Clinton Francis (Added Dec 11, 2018)  
Contact - Elise Fiskum (Added Sep 28, 2021)  
Contact - Emily Christensen (Added Feb 5, 2020)  
Contact - Emily Levin (Added Sep 28, 2021)  
Contact - Emma Saenger (Added Sep 21, 2020)  
Contact - Emma Weitzner (Added Jan 19, 2017)  
Contact - Emma Weitzner (Added Feb 20, 2017)  
Contact - Emma Weitzner (Added Apr 25, 2018)  
Contact - Emma Weitzner (Added Oct 2, 2018)  
Contact - Gabriel Santos Elizondo (Added Jul 12, 2019)  
Contact - Gillian Ippoliti (Added Mar 16, 2021)  
Contact - Heather E Liwanag (Added Jan 16, 2020)  
Contact - Heather E Liwanag (Added Jul 21, 2021)  
Contact - Joscelyn De La Torre (Added Feb 5, 2020)  
Contact - Kaitlyn Kaiser (Added Feb 5, 2020)  
Contact - Kate Riordan (Added Sep 21, 2020)  
Contact - Kate Riordan (Added Aug 2, 2021)  
Contact - Linnea Erin Pearson (Added Feb 20, 2017)  
Contact - Linnea Erin Pearson (Added Feb 20, 2017)  
Contact - Madeline Schroth-Glanz (Added Oct 2, 2018)  
Contact - Madeline Schroth-Glanz (Added Dec 11, 2018)  
Contact - Melissa Voisinet (Added Feb 20, 2017)  
Contact - Melissa Voisinet (Added Apr 25, 2018)  
Contact - Melissa Voisinet (Added Jul 25, 2016)

**Contact** - Melissa Voisinet (Added Jan 23, 2017)

**Contact** - Molly Murphy (Added Jul 19, 2021)

**Project Description** - (Added Dec 11, 2018)

**References** - (Added Dec 11, 2018)

**Resources Needed** - (Added Dec 11, 2018)

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## Status

**Application Status:**

Application Complete

**Date Submitted:**

December 11, 2018

**Date Completed:**

October 4, 2018

**FR Notice of Receipt Published:**

December 26, 2018    **Number:** 2018-27870

**Comment Period Closed:**

February 25, 2019    **Comments Received:** No    **Comments Addressed:** No

**Last Date Archived:**

September 28, 2021

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### • MMPA Research/Enhancement permit

**Current Status:** Issued    **Status Date:** April 10, 2018

**Section 7 Consultation:** N/A

**NEPA Analysis:** Categorical Exclusion

**Expire Date:** March 31, 2024

#### Analyst Information:

1) Sara Young	Phone: (301)427-8484 Email: sara.young@noaa.gov
2) Shasta McClenahan	Phone: (301)427-8447 Email: shasta.mcclenahan@noaa.gov

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## Modification Requests

### Modifications Requested

Number	Title	Description	Status	Date Submitted	Date Issued	Issued Version

1	Add a field team leader	We are requesting to authorize Gabriel Santos Elizondo as a field team leader on this permit. Gabriel has been working with our team for two years, and has demonstrated both an ability to safely handle elephant seals and an ability to train others in proper handling techniques. Because two of our field team leaders have graduated and will not be participating in the study to the same degree, we need to add an experienced team leader to maintain our research effort. We have attached a detailed description of Gabriel's field experience with elephant seals and other large mammals, and a revised version of the personnel table.	Issued	07/12/2019	07/29/2019
2	Allow the use of unmanned aerial vehicles for population surveys	We are requesting a modification to our original permit in an attempt to decrease human-seal interactions and harassment and to increase population census precision and efficiency. In order to achieve these goals, we wish to test the efficacy of using Unmanned Aerial Systems (UAS) for performing regular northern elephant seal population censuses at Piedras Blancas. Description of modification: Perform twice weekly, comprehensive population surveys of the beaches at Piedras Blancas using Unmanned Aerial Systems (UAS). Reason for modification: During the elephant seal breeding season, it is challenging to accurately estimate population numbers from our researchers' peripheral position on the beach. The seals often blend in to the environment or are out of eyesight (i.e., hidden behind each other). We expect the use of UAS for surveys will increase both the accuracy and precision of our censuses, without introducing the additional disturbance that would be associated with regular ground surveys conducted by researchers walking on the beaches among the animals. UAS have been utilized across scientific disciplines and in multiple field studies across the world, and they have been used successfully for surveying a variety of animal species, including marine mammals (Watts et al. 2010; Smith et al. 2016; Fiori et al. 2017). Using UAS to assess low altitude wildlife populations is safer for humans and often more cost-effective than traditional survey methods (Smith et al. 2016; Seymour et al. 2017). By and large, UAS have been shown to enable the collection of more precise data while minimizing behavioral disturbances (Pomeroy et al. 2015; Seymour et al. 2017). The addition of UAS to this project will reduce errors caused by variations in the survey path, increase the time spent surveying focal animals, and minimize the amount of disturbance to the general population (Smith et al. 2016). Different species react differently to the types of disturbance (i.e., noise and/or shadows) introduced by UAS (Smith et al. 2016; Mulero- Pázmány et al. 2017); northern elephant seals have been shown to be extremely robust to such disturbances and exhibit minimal or no reactions compared to other pinniped species (e.g., harbor seals and California sea lions), even when in proximity of a missile launch (Holst et al. 2011). Methods: This work will be conducted in collaboration with the Autonomous Flight Lab (AFL) at Cal Poly. The AFL is a student research laboratory at Cal Poly focusing on applications of unmanned aerial systems (UAS). The lab is led by Dr. Aaron Drake, who has extensive experience operating professional and military UAS. Currently, there are 3 graduate and 4 undergraduate student assistants working in the lab, mostly from the Aerospace Engineering department. The lab has 5 commercial unmanned aerial vehicles (UAVs) that are regularly operated. In the history of the lab there have been 0 injuries to involved and uninvolved personnel as well as 0 vehicle crashes. The lab has extensive maintenance and operational procedures to ensure that the vehicles are always kept at or above manufacturer standards. The AFL has extensive experience operating UAS in demanding environments. For example, the AFL has operated UAS in the Sierra Nevada mountains for a wildlife tracking project with the US forest service. In addition to the FAA, the AFL is familiar working with other governmental agencies to be in compliance with all applicable regulations. Based on all of this, the AFL will provide a safe and reliable resource for aerial UAS surveys. The team will be using one of 3	Issued	10/30/2019	01/28/2020

UAS: RQ-20 Puma AE, Vapor 55, or Quantix, all of which are made by Aerovironment. Only one UAS will be operated at a time. The UAS will fly continuously within the beach designated area while taking images. These surveys above the beach will produce a series of overlapping still images that can be stitched together to create a single large image. The UAS will be flown at a minimum altitude of 150 feet in order to minimize disturbance to the wildlife. We expect disturbance to be negligible relative to ambient noise (waves, gulls calling, other seals, etc.), particularly given the resilience of northern elephant seals to ambient noise during rocket launches (Holst et al. 2011). The team will actively monitor for disturbances during the flight and change the flight altitude and flight path as needed. The surveys will occur twice per week throughout the elephant seal breeding season (December through April). Flight days will be determined according to weather conditions, and flights will take place in the early morning (between 8am and 10am). The team will add a safety buffer of at least 75% to the flight time to ensure the vehicle can safely land before the battery runs out, which is standard practice for the AFL. Moreover, the UAS will remain within line-of-sight for the entire duration of all flights, and the launch/landing location will be away from all other people and non-target wildlife. The UAS will never be operated over the water, in accordance with NOAA regulations. It will be operated according to FAA, NOAA, and relevant State Park regulations, and will only be operated by an FAA certified remote pilot. The AFL will have at least one member with Part 107 certification on site at all times. Currently there are 3 certified pilots on staff. If a certified pilot is not available, the UAS surveys will not be conducted at that time. The team will avoid disturbing marine mammals and birds by flying at the maximum altitude that will produce usable images for censuses (always between 150 and 400 ft). Additionally, we will monitor marine mammals and birds continuously and take corrective action in the case of a disturbance. If an animal does get disturbed by the UAS, the behavior will be described following Pomeroy et al. (2015). There will be no concurrent research activities other than observation for potential disturbances while the UAS is in flight. To ensure minimal disturbance to the seals, one of the Cal Poly biologists listed on the permit will be present to supervise flights over the rookery. We have attached Dr. Aaron Drake's FAA license and a list of experience for Dr. Drake and two of the student pilots. The pilot operating the vehicle will have a current FAA license at the time of flight, per federal regulations. Below are detailed descriptions of each UAS: Aerovironment Vapor 55: This is a rotorcraft with a maximum take-off weight (MTOW) of 55 pounds and a fuselage length of 77 inches. It is powered by LiPo batteries with a maximum flight duration of 45 minutes. Survey flights will only be planned to a length of 30 minutes to mitigate the risk of battery depletion. The Vapor 55 has a climb rate of 390 feet per minute and a maximum speed of 20 knots. Data will be collected with a Sony A7 camera secured to a mounting point on the air vehicle. Flights are pre-planned using the mission planning software, but the Vapor 55 can be commanded to return to the landing site at any point during the flight. The ground station includes a laptop computer with a transceiver to control the air vehicle and the payload. The Autonomous Flight Lab (AFL) at Cal Poly always has at least a 3-person crew to operate this vehicle. This includes the air vehicle operator, monitor, and air observer. The monitor essentially acts as a copilot, helping the vehicle operator with situational awareness, including battery levels. The air observer monitors for air traffic in the sky. More information on the AFL can be found in the supplemental information. Aerovironment RQ-20 Puma: This is a hand-launched, fixed wing aircraft with a MTOW of 15 pounds and a wingspan of 100 inches. It has a maximum flight duration of 2 hours, which provides ample endurance to cover any of the beaches. The Puma climbs at a rate of 800 feet per minute and has a descent rate of 1000 feet per minute. It cruises at 25 knots

and tops out at 40 knots in steady conditions. Data will be collected with the stock camera payload provided by Aerovironment. The stock payload can be swapped out with a FLIR infrared camera to collect data in the infrared and near-infrared spectrum. Flights are planned on-site with 4 movable waypoints that can be updated to cover the entire site. The Puma can be commanded to return to a landing waypoint at any point during the flight, or switched into a manual mode where the air vehicle operator can manually pilot the vehicle to a chosen location. The Puma performs a "deep stall landing," during which it comes down at a 1:1 glide ratio and impacts the ground. This means it does not require a runway of any sort and can be launched and landed on rough terrain. The ground station includes a laptop computer and a hand controller. The AFL always has at least a 3-person crew to operate this vehicle. This includes the air vehicle operator, mission operator, and air observer. The air vehicle operator controls the vehicle on launch and landing with the hand controller, but passes control to the mission operator, who controls the aircraft during the mission via waypoints on the laptop. The third crew member is the air observer, who monitors for air traffic.

Aerovironment Quantix: This is a vertical take-off and landing (VTOL) UAV with a MTOW of 5 pounds and a footprint of 38" x 15". It has a maximum cruise duration of 45 minutes designed to cover up to 400 acres. The selected survey sites are all within these limits, but new batteries will be used for each flight to mitigate the risk of running down a battery pack. The Quantix climbs to a pre-defined altitude (minimum 150 feet) in a vertical configuration, then transitions into a horizontal configuration to perform data collection. It cruises at ~35 knots and provides a live readout of wind and data link status to the air vehicle operator. Data will be collected with the stock visual and near-infrared cameras included in the Quantix system. The data collection area is preprogrammed into the system and then the Quantix determines a suitable flight area to complete the survey. The air vehicle can be commanded to return to the landing site at any point during the flight. The ground station for this vehicle only includes a tablet with a built-in transceiver. The AFL uses at least 2 crew members to operate this vehicle. The roles are air vehicle operator and air observer. This vehicle is highly automated, so it only requires one person to fly.

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3	Add additional field team leaders	We are requesting to authorize Emily Christensen, Joscelyn De La Torre, and Kaitlyn Kaiser as field team leaders on this permit. These individuals have been working with our team for at least one or two years, and each has demonstrated both an ability to safely handle elephant seals and an ability to train others in proper handling techniques. Because two of our field team leaders have graduated, and another has suffered an unrelated injury that prevents her from participating in field work, we are in need of additional, experienced team leaders to maintain our research effort. We have attached a detailed description of each person's field experience with elephant seals, and a revised version of the personnel table.	Issued	02/05/2020	02/26/2020
4	Add additional field team leaders	We are requesting to authorize Catie Halvorsen, Bryce King, Kate Riordan, and Emma Kate Saenger as field team leaders on this permit. These individuals have been working with our team for at least one year, and each has demonstrated both an ability to safely handle elephant seals and an ability to train others in proper handling techniques. As we head into another breeding season, our previous field team leaders have graduated, and we are in need of additional, experienced team leaders to maintain our research effort. We have attached a detailed description of each person's field experience with elephant seals, and a revised version of the personnel table.	Issued	09/21/2020	10/08/2020
5	Add a field team leader and authorized recipient	We are requesting to authorize Gillian Ippoliti as a field team leader on this permit. This individual has been working with our team since 2019, and has demonstrated both an ability to safely handle elephant seals and an ability to train others in proper handling techniques. We have attached a detailed description of this person's field experience with elephant seals, and a revised version of the personnel table. In addition, we are requesting to list Dr. Roxanne Beltran (UC Santa Cruz) as an authorized recipient of skin samples salvaged from tagging efforts, for inclusion in her range-wide genetics study. This has been added to the personnel table.	Issued	03/16/2021	03/26/2021
6	Deployment of satellite tags on weanling elephant seals	Description of Modification We are requesting modification to our original permit to allow the deployment of satellite transmitters on newly weaned northern elephant seals (NES) in an attempt to better understand the movement patterns of young NES during their first year. This project will involve tracking weanlings from the Vandenberg Space Force Base (VSFB) and Piedras Blancas (PB) rookeries, which will allow our team to compare the migration paths of the weanlings between a newly established and a longer term rookery. The goals of this project are: (1) to address the question of whether these pups instinctively seek the same foraging areas as other elephant seal pups or if they stay relatively close to their birthplace on their first migration; (2) to determine whether the migration paths of the weanlings differ between these two rookeries; and (3) to identify the relative importance of foraging areas near rookeries. A better understanding of first-year dispersal and foraging behavior of NES will not only benefit our scientific knowledge of NES, but will also contribute important information to the monitoring and management of the species. Reason for Modification Sexual segregation in adult foraging migration locations is well documented in NES (Le Boeuf et al., 1993, 2000; Stewart, 1997); male NES tend to forage in coastal areas, along the continental shelf, whereas female NES forage in deeper waters offshore. However, we currently do not know whether naïve seal pups tend to follow innate cues or whether they first explore the ocean closer to their birthplace before venturing into adult foraging territory. This project will provide insight into the at-sea movements of naïve animals from a newly established rookery (VSFB, est. 2017). Comparison of animals from VSFB with animals from a more established rookery (PB) will help us to understand whether at-sea movements are instinctual for the species as a whole or dependent on the animal's birthplace. Age-specific mortality is highest for NES in the first year of life, and	Submitted	07/21/2021	

the majority of that mortality occurs at sea (Le Boeuf et al., 1994). Knowledge of their at-sea movements during this critical time in their life history, as well as the extent to which these movements may differ between rookeries, will help inform management of the species and determine relative importance of foraging areas near rookeries. In particular, understanding whether younger animals utilize waters closer to their natal beaches will provide insight to VFSB regarding how important the surrounding waters are to this new population at its most vulnerable life stage. Additionally, top predators like NES are especially sensitive to the shifting of prey resources with climate change, and can serve as a sentinel species for ocean health (Hazen et al., 2019). Comparison of data across years will provide insight into how young NES respond to climatic changes. This project aligns with Vandenberg's Integrated Natural Resources Management Plan (INRMP), which includes requirements for the base to cooperate with regulatory agencies for the conservation, protection, and management of VSFB fish and wildlife resources, especially species like NES that are protected by Federal law. Cooperation with local academic institutions is also encouraged under the Sikes Act Improvement Act. Because of this, we have secured funding through the Department of Defense, Army Corps of Engineers to perform this study. A better understanding of first-year dispersal and foraging behavior of NES following their birth at VSFB will not only benefit our scientific knowledge of NES, but will also contribute important information to monitoring and management requirements of the species in support of the space launch mission at Vandenberg. VSFB personnel expect to assess the results of this behavioral and dispersal research and ascertain better information on movement patterns with intent to lessen their regulatory burden. They are currently required to monitor potential effects of space launch on NES from 1 January to 28 February each year; with more complete supporting information, this monitoring could be significantly reduced in the near future.

**Methods**

To investigate the at-sea behavior of newly weaned NES from VSFB, we will deploy satellite transmitters on animals born at VSFB ( $34^{\circ}33'41.8''N$   $120^{\circ}37'57.4''W$ ) and PB ( $35^{\circ}38'52.4''N$   $121^{\circ}12'48.2''W$ ) during the breeding season (December-March). In the first year of the project, we will deploy satellite transmitters on 5 newly weaned pups at VSFB. In each of the two years following, we will deploy satellite transmitters on 5 weanlings at VSFB and 5 weanlings at PB for comparison (cumulative tagged individuals: VSFB = 15 and PB = 10). Timing of field work at VSFB will be carefully planned, such that the elephant seals at the breeding beach have weaned but harbor seals have not yet pupped; this will prevent the chance of mother-pup separation for harbor seals. We anticipate that any adult harbor seals on that beach will flush during our procedures, and we have included takes in the take table to account for that. Based on our previous work at this beach, the harbor seals will remain in the water nearby and will repopulate the beach approximately 30 min after we vacate the area. Animal handling will involve a team of 6-8 trained personnel. Prior to handling any animals, all potential study candidates will be visually evaluated from a distance. Any animals in poor body condition (body condition score 1 or 2 out of 5) or with severe injuries will not be considered for satellite tagging and will not be handled. Potential candidate weanling NES will be captured in a specially-designed canvas bag and physically examined by a licensed marine mammal veterinarian to evaluate health status. Sex will be determined visually by lifting the hind flippers. Animals with any clinical signs of injury or disease will be released immediately without further handling. In order to facilitate sex comparisons, a healthy animal may also be released at this stage to maintain a balanced sex ratio of study animals. Good study candidates will be suspended from an electronic scale and carbon fiber tripod to determine mass prior to sedation. The weighing procedure typically takes 5-8 min. Weanlings will be sedated by a veterinarian using Telazol (tilotamine/zolazepam

combination) administered IM in the dorsal musculature of the hip region at 1-2 mg/kg based on their mass. This combination drug has been used widely in NES at this low dose range during clinical care and field research with minimal adverse effects (Simmons et al., 2010; Champagne et al., 2012; Haulena and Schmitt, 2018). This dose should provide adequate sedation for approximately 45 minutes to facilitate satellite tag application and minimally invasive biological sampling. If the sedation effects are inadequate during the first half of the procedure, an additional injection of Telazol may be given at half the original dose IM or IV. Sedated animals will be monitored continuously by a licensed veterinarian or registered veterinary technician until fully recovered to evaluate trends in vital signs and level of responsiveness. Emergency response drugs, equipment, and antibiotics will be available if needed for study animals. As a contingency in the unlikely event that an animal becomes severely injured during handling or is unable to recover from sedation, potassium chloride solution will be available for low-residue humane euthanasia, in consultation with NOAA (Whitmer et al., 2021). We will attach an ARGOS-linked satellite transmitter (SPOT-287, Wildlife Computers; L×W×H = 70×41×23 mm, mass = 72g) on or just behind the head, using quick-set marine epoxy (Loctite 5-minute epoxy). To facilitate recapture of animals and recovery of the satellite tags, we will also attach a VHF transmitter (MM100, Advanced Telemetry Systems) to the back of the animal using epoxy. To assess body condition, we will visually evaluate patients using a standardized body condition scoring system, take standard morphometric measurements (including curvilinear and standard length, as well as girth measurements), and measure blubber thickness using a portable ultrasound. Prior to collecting blood from the extradural sinus, the skin over the site will be thoroughly cleaned and aseptically prepared with 70% isopropyl alcohol. A sterile 20 gauge, 1.5-2.0 inch needle with vacutainer attachment will be inserted into the extradural sinus to collect a maximum of 20 ml of blood directly into sterile vacutainer blood tubes. This volume is far below the recommended blood collection safety guideline not to exceed 1% of body weight. Sterile polyester swabs will be collected from nasal and rectal orifices and stored in sterile cryovials. Blood and swabs will be used for routine clinical evaluation and to archive for future comparative disease investigation studies. These minimally invasive biological sampling procedures performed by experienced veterinary professionals should have no anticipated detrimental effects on the animals. Samples will be stored in a portable cooler with ice packs for transport to the laboratory, where they will be processed and stored in a -80 freezer until analysis. Satellite locations will be retrieved regularly through the ARGOS system (which includes satellites launched from VSFB), allowing us to track the animals in near real time. Although we will attempt to retrieve the transmitters opportunistically if animals haul out at locations where we can reach them, we will be able to obtain location data whether or not the transmitters are successfully retrieved. Because the transmitters will be shed when the animals molt the following year, we will attempt to retrieve them prior to that time. If a tagged seal hauls out in a potentially accessible location after its first at-sea migration, we will use its VHF signal to find the exact location of the seal. We will capture the seal in a net or canvas bag and determine its mass empirically (suspended from an electronic scale and carbon fiber tripod) or by visual estimation, depending on what is logistically feasible at the capture site. If conditions require an expedited tag recovery, we may attempt to remove the tags under manual restraint. If the use of manual restraint is not safe and/or conditions allow for a longer handling procedure, a licensed veterinarian will sedate the seal with Telazol administered IM in the dorsal musculature of the hip region at 1 mg/kg; mass will either be estimated visually or determined empirically using the methodology described above. A tag recovery procedure involving sedation will allow us to remove the tags and repeat

		<p>morphometric measurements, blubber ultrasound, blood draw, and nasal and rectal swabs. Sedated animals will be monitored continuously by a licensed veterinarian or registered veterinary technician until fully recovered to evaluate trends in vital signs and level of responsiveness. We will use satellite data to determine transit rates, which we will then use to estimate focal foraging areas (Le Boeuf et al., 2000). We will compare focal foraging areas, final destination, and maximum distance traveled from the rookery between sexes, between rookeries, and among years. For seals that were recaptured, we will compare pre- and post-migration mass, morphometric measurements, and blubber thicknesses to estimate foraging success during the first migration. References Champagne, C.D., Houser, D.S., Costa, D.P., and Crocker, D.E. (2012) The effects of handling and anesthetic agents on the stress response and carbohydrate metabolism in northern elephant seals. PLoS ONE 7(5): e38442. Haulena, M and Schmitt, T. (2018) Anesthesia. In: Gulland, F.M.D., Dierauf, L.A., and Whitman, K. L., eds. CRC Handbook of Marine Mammal Medicine, 3rd Edition. Boca Raton: CRC Press. Hazen, E.L., Abrahms, B., Brodie, S., Carroll, G., Jacox, M.G., Savoca, M.S., Scales, K.L., Sydeman, W.J., and Bograd, S.J. (2019) Marine top predators as climate and ecosystem sentinels. Frontiers in Ecology and the Environment 17: 565-574. Le Boeuf, B.J., Crocker, D.E., Blackwell, S.B., Morris, P.A., and Thorson, P.H. (1993) Sex differences in diving and foraging behaviour of northern elephant seals. Symposia of the Zoological Society of London 66: 149-178. Le Boeuf, B.J., Crocker, D.E., Costa, D.P., Blackwell, S.B., Webb, P.M., and Houser, D.S. (2000) Foraging ecology of northern elephant seals. Ecological Monographs 70(3): 353-382. Le Boeuf, B.J., Morris, P., and Reiter, J. (1994) Juvenile survivorship of northern elephant seals. In: Le Boeuf, B.J. and Laws, R.M., eds. Elephant Seals: Population Ecology, Behavior, and Physiology. Berkeley: University of California Press. Simmons, S.E., Crocker, D.E., Hassrick, J.L., Kuhn, C.E., Robinson, P.W., Tremblay, Y., and Costa, D.P. (2010) Climate-scale hydrographic features related to foraging success in a capital breeder, the northern elephant seal <i>Mirounga angustirostris</i>. Endangered Species Research 10: 233-243. Stewart, B.S. (1997) Ontogeny of differential migration and sexual segregation in northern elephant seals. Journal of Mammalogy 78(4): 1101-1116. Whitmer, E.R., Trumbull, E.J., Harris, H.S., Whoriskey, S.T., and Field, C.L. (2021) Use of potassium chloride for low-residue euthanasia of anesthetized California sea lions (<i>Zalophus californianus</i>) and northern elephant seals (<i>Mirounga angustirostris</i>) with life-threatening injury or disease. Journal of the American Veterinary Medical Association 259(2): 1-5.</p>			
7	Add additional field team leaders	We are requesting to authorize Molly Murphy, Elise Fiskum, Anika Lewis, and Emily Levin as field team leaders on this permit. These individuals have been working with our team for at least one year, and each has demonstrated both an ability to safely handle elephant seals and an ability to train others in proper handling techniques. As we head into another breeding season, we are in need of additional, experienced team leaders to maintain and enhance our research effort. We have attached a Qualifications Form for each individual, as well as a revised version of the personnel table. Molly Murphy will be conducting her master's thesis on mother-pup acoustic interactions, and she has trained under supervision to perform the acoustics methodology; she is now ready to lead that project.	Issued	07/19/2021	09/27/2021
8	Modify methodology for UAVs	We are requesting a modification to our UAV methodology, which was approved under Modification #2 of the existing permit. Description of modification: Perform twice weekly, comprehensive population surveys of the beaches at Piedras Blancas using Unmanned Aerial Systems (UAS). Reason for modification: We need to modify the methodology for this protocol, because our planned collaboration fell through. Instead, we will use our own UAS and	Issued	08/25/2021	09/27/2021

our own FAA certified pilots to conduct the work. Changes relative to previous protocol: The primary change we are requesting is the use of our own UAS and pilots for the work. Because our UAS is small and has a limited flight time (maximum 30 minutes), we may need to perform flights 4-5 days per week to ensure twice weekly coverage of all beaches within the rookery. The UAS vehicles previously authorized had flight times ranging from 45 minutes to 2 hours (see below). Specs for current UAS (DJI Phantom 4 Pro v2.0): vertical takeoff/landing; weight = 1380 g with battery; max flight time = 30 minutes; diagonal size = 350 mm; max lateral speed = 60 ft/sec; max ascent speed = 18 ft/sec; max descent speed = 12 ft/sec; max operational range = 3.1 miles There are three UAS vehicles that were previously approved for this protocol. Specs follow, for comparison to the current UAS. (1) Aerovironment Vapor 55: vertical takeoff/landing; weight = 19 lbs; max flight time = 45 minutes; rotor diameter = 90 in. (2) Aerovironment RQ 20 Puma: fixed wing aircraft; weight = 14 lbs; max flight time = 2 hours; wing span = 9.2 ft; length = 4.6 ft. (3) Aerovironment Quantix: vertical takeoff/landing; weight = 5 lbs; max flight time = 45 minutes; footprint = 38 x 15 in. Note: We do not anticipate the need for additional takes with this protocol, as we are still planning twice weekly coverage of the rookery as a whole. Background: During the elephant seal breeding season, it is challenging to accurately estimate population numbers from our researchers' peripheral position on the beach. The seals often blend in to the environment or are out of eyesight (i.e., hidden behind each other). We expect the use of UAS for surveys will increase both the accuracy and precision of our censuses, without introducing the additional disturbance that would be associated with regular ground surveys conducted by researchers walking on the beaches among the animals. UAS have been utilized across scientific disciplines and in multiple field studies across the world, and they have been used successfully for surveying a variety of animal species, including marine mammals (Watts et al. 2010; Smith et al. 2016; Fiori et al. 2017). Using UAS to assess low altitude wildlife populations is safer for humans and often more cost-effective than traditional survey methods (Smith et al. 2016; Seymour et al. 2017). By and large, UAS have been shown to enable the collection of more precise data while minimizing behavioral disturbances (Pomeroy et al. 2015; Seymour et al. 2017). The addition of UAS to this project will reduce errors caused by variations in the survey path, increase the time spent surveying focal animals, and minimize the amount of disturbance to the general population (Smith et al. 2016). Different species react differently to the types of disturbance (i.e., noise and/or shadows) introduced by UAS (Smith et al. 2016; Mulero- Pázmány et al. 2017); northern elephant seals have been shown to be extremely robust to such disturbances and exhibit minimal or no reactions compared to other pinniped species (e.g., harbor seals and California sea lions), even when in proximity of a missile launch (Holst et al. 2011). Methods: This work will be conducted using our own UAS, similar to the methodology used by the team at Año Nuevo. Our team will be utilizing a DJI Phantom 4 Pro v2.0 UAS. Our lab performs extensive pre-flight and post-flight operational procedures to ensure that the vehicle is always kept at or above manufacturer standards and only operated under conditions within an acceptable margin of manufacturer recommendations. A pre-flight checklist will be performed prior to each flight to ensure the UAS is in operable condition with undamaged rotors and a full battery. Extra batteries will be on site to ensure sufficient operational time. Environmental conditions will be assessed to ensure safe operation of the vehicle. A Kestrel handheld anemometer will be utilized to confirm wind speed is under 15mph. The flight will be canceled if precipitation is observed or anticipated. The drone will stay within line of sight of the operator for the duration of the flight. Flight times will be limited to 20 minutes per battery. The UAS will fly continuously within the beach designated area while

taking images. These surveys above the beach will produce a series of overlapping still images that can be stitched together to create a single large image. The UAS will be flown at an altitude of 120-400 feet in order to minimize disturbance to the wildlife. This altitude allows for ideal visual monitoring of the aircraft by spotters and enables the capturing of high-resolution photographs of the seals for biological review. Most flights will occur at the lower end of the altitude range. We expect disturbance to be negligible relative to ambient noise (waves, gulls calling, other seals, etc.), particularly given the resilience of northern elephant seals to ambient noise during rocket launches (Holst et al. 2011). The team will actively monitor for disturbances during the flight and change the flight altitude and flight path as needed. The surveys will occur up to twice per week at each beach throughout the elephant seal breeding season (December through April), and up to once per week at each beach during the rest of the year. Because we have several unconnected beaches at this rookery, we may need to perform flights 4 or 5 days per week to ensure sufficient coverage of every beach, particularly during the breeding season. In order to cover all beaches twice per week, we will perform individual flights over 2-3 beaches per day. Due to the limitations of UAS battery life and daylight hours available before peak public visitation, we cannot cover all beaches in a single day. Flight days will be determined according to weather conditions, and flights will take place in the early morning (between 7am and 10am). Flight times include a safety buffer of at least 75% to the flight time to ensure the vehicle can safely land before the battery runs out. The UAS will remain within line-of-sight for the entire duration of all flights, and the launch/landing location will be away from all other people and non-target wildlife. The UAS will never be operated over the water, in accordance with NOAA regulations. It will be operated according to FAA, NOAA, and relevant State Park, National Marine Sanctuary, and USFW regulations, and will only be operated by an FAA certified remote pilot. Our lab will have at least one member with Part 107 certification on site at all times. If a certified pilot is not available, the UAS surveys will not be conducted at that time. The team will avoid disturbing marine mammals and birds by flying at the maximum altitude that will produce usable images for censuses (always between 120 and 400 ft). Additionally, we will monitor marine mammals and birds continuously and take corrective action in the case of a disturbance. If an animal does get disturbed by the UAS, the behavior will be described following Pomeroy et al. (2015). There will be no concurrent research activities at that particular beach other than observation for potential disturbances while the UAS is in flight. Below is a detailed description of the UAS: The DJI Phantom 4 Pro v2.0 is a quadcopter vertical takeoff and landing system weighing 1380g and bearing a gimballed camera system. It is powered by a single LiPo 4S battery enabling 30 minutes of continuous flight. Flights will be constrained to 20 minutes or less to avoid depletion. The craft has a maximum ascent speed of 18 feet per second and a maximum descent speed of 12 feet per second, with a maximum lateral speed of 60 feet per second. The craft has a maximum operational range of 3.1 miles when unobstructed. All flights will take place well within this distance and inside visual range. Vision and data collection are accomplished with a digital 20mm camera with a field of view of 94 degrees, creating optimal situational awareness. The UAS is capable of manual or pre-programmed automated flight modes. Automated flight capability will be utilized with set photography points established via GPS coordinates. This will ensure photography is consistent between flights and enables shorter flight times than are possible through manual operation. The UAS is capable of manual override at any point, in case of circumstances necessitating an emergency landing. The ground station will consist of an FCC compliant handheld radio transmission system capable of utilizing any smartphone or tablet for visual display. Ground crew will consist of an FAA certified Part 107 UAS pilot operating the remote

controller, with two designated spotters to monitor for disturbance of either target or non-target species and to ensure safe operation of the UAS. Handheld radios will be utilized to ensure the pilot and spotters are always capable of communication. The pilot will continuously monitor aircraft status and condition and will intervene and assume manual control in the event of unexpected circumstances. The spotters will assist the pilot remotely with situational awareness and the progress of the flight, and will relay any important environmental information or unexpected air traffic to the pilot. The following personnel have obtained FAA Part 107 certification to fly the UAS and have logged hours over domestic animals in preparation for this protocol: Elise Fiskum, Anika Lewis, Molly Murphy, and Kate Riordan. An updated Qualification Form has been uploaded for each of these pilots. References Cited: Fiori, L., Doshi, A., Martinez, E., Orams, M.B., and Bolland-Breen, B. (2017) The use of unmanned aerial systems in marine mammal research. *Remote Sensing* 9(6): 543. Fritz, L. (2012) By land, sea, and air: a collaborative Steller sea lion research cruise in the Aleutian Islands. *NOAA Fisheries, Alaska Fisheries Science Center Quarterly Report*, January–February–March 2012. Holst, M., Lawson, J.W., Richardson, J.W., Schwartz, S.J., and Smith, G. (2011) Pinniped responses during Navy missile launches at San Nicolas Island, California. *Aquatic Mammals* 37(2): 139–150. Mulero-Pázmány, M., Jenni-Eiermann, S., Strelbel, N., Sattler, T., Negro, J.J., and Tablado, Z. (2017) Unmanned aircraft systems as a new source of disturbance for wildlife: A systematic review. *PLoS ONE* 12(6): e0178448. Pomeroy, P., O'Connor, L., and Davies, P. (2015) Assessing use of an reaction to unmanned aerial systems in gray and harbor seals during breeding and molt in the UK. *Journal of Unmanned Vehicle Systems* 3(3): 102–113.. Smith, C.E., Sykora-Bodie, S.T., Bloodworth, B., Pack, S.M., Spradlin, T.R., and LeBoeuf, N.R. (2016) Assessment of known impacts of unmanned aerial systems (UAS) on marine mammals: data gaps and recommendations for researchers in the United States. *Journal of Unmanned Vehicle Systems* 4(1): 31–44. Seymour, A.C., Dale, J., Hammill, M., Halpin, P.N., and Johnston, D.W. (2017) Automated detection and enumeration of wildlife using unmanned aerial systems (UAS) and thermal imagery. *Scientific Reports* 7: 45127. Watts, A.C., Perry, J.J., Smith, S.E., Burgess, M.A., Wilkinson, B.E., Santoi, Z., ... and Percival, H.F. (2010) Small unmanned aircraft systems for low-altitude aerial surveys. *The Journal of Wildlife Management* 74(7): 1614–1619.

## Reports

### Reports Required

Nbr	Report Type	Report Period		Date Due	Status	Date Received
		Start Date	End Date			
1	Annual	04/10/2019	03/31/2020	06/30/2020	Submitted	08/07/2020
2	Annual	04/01/2020	03/31/2021	06/30/2021	Submitted	05/23/2021
3	Annual	04/01/2021	03/31/2022	06/30/2022	N/A	
4	Annual	04/01/2022	03/31/2023	06/30/2023	N/A	
5	Combined Annual/Final	04/01/2023	03/31/2024	06/30/2024	N/A	